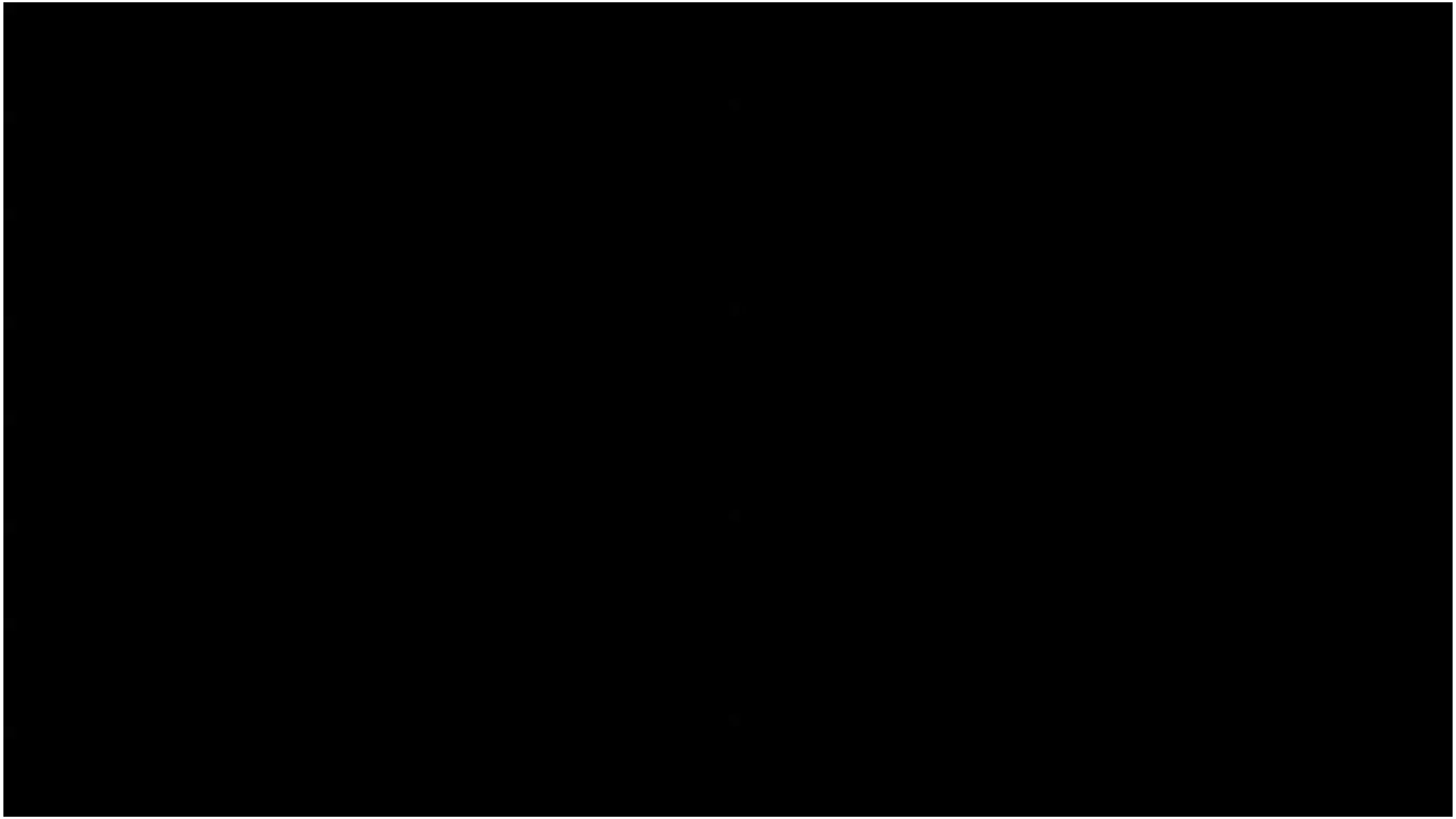

Premiers résultats de la mission *Planck*

JB Melin

17 janvier 2011

irfu
cea
saclay

HFI PLANCK

Grandes étapes

- 14 mai 2009 : lancement de *Planck*
- fin juin 2009 : HFI refroidi à 100mK
- début août 2009 : « First Light Survey »
- et depuis : prise de données en continu

janvier 2011 : publication des résultats obtenus sur les 10 premiers mois de données (*plus d'un ciel complet*)

Planck 2011


THE MILLIMETER AND SUBMILLIMETER SKY
IN THE PLANCK MISSION ERA
PARIS, FRANCE
JANUARY 10-14 2011
CITÉ DES SCIENCES

Les premiers papiers Planck

Title	Authors	Publication
Planck early results 01: The Planck mission	Planck Collaboration	2011 submitted to A&A
Planck early results 02: The thermal performance of Planck	Planck Collaboration	2011 submitted to A&A
Planck early results 03: First assessment of the Low Frequency Instrument in-flight performance	Mennella et al.	2011 submitted to A&A
Planck early results 04: First assessment of the High Frequency Instrument in-flight performance	Planck HFI Core Team	2011 submitted to A&A
Planck early results 05: The Low Frequency Instrument data processing	Zacchei et al.	2011 submitted to A&A
Planck early results 06: The High Frequency Instrument data processing	Planck HFI Core Team	2011 submitted to A&A
Planck early results 07: The Early Release Compact Source Catalogue	Planck Collaboration	2011 submitted to A&A
The Explanatory Supplement to the Planck Early Release Compact Source Catalogue	Planck Collaboration	2011 ESA
Planck early results 08: The all-sky early Sunyaev-Zeldovich cluster sample	Planck Collaboration	2011 submitted to A&A
Planck early results 09: XMM-Newton follow-up for validation of Planck cluster candidates	Planck Collaboration	2011 submitted to A&A
Planck early results 10: Statistical analysis of Sunyaev-Zeldovich scaling relations for X-ray galaxy clusters	Planck Collaboration	2011 submitted to A&A
Planck early results 11: Calibration of the local galaxy cluster Sunyaev-Zeldovich scaling relations	Planck Collaboration	2011 submitted to A&A
Planck early results 12: Cluster Sunyaev-Zeldovich optical scaling relations	Planck Collaboration	2011 submitted to A&A
Planck early results 13: Statistical properties of extragalactic radio sources in the Planck Early Release Compact Source Catalogue	Planck Collaboration	2011 submitted to A&A
Planck early results 14: Early Release Compact Source Catalogue validation and extreme radio sources	Planck Collaboration	2011 submitted to A&A
Planck early results 15: Spectral energy distributions and radio continuum spectra of northern extragalactic radio sources	Planck Collaboration	2011 submitted to A&A
Planck early results 16: The Planck view of nearby galaxies	Planck Collaboration	2011 submitted to A&A
Planck early results 17: Origin of the submillimetre excess dust emission in the Magellanic Clouds	Planck Collaboration	2011 submitted to A&A
Planck early results 18: The power spectrum of cosmic infrared background anisotropies	Planck Collaboration	2011 submitted to A&A
Planck early results 19: All-sky temperature and dust optical depth from Planck and IRAS – constraints on the "dark gas" in our Galaxy	Planck Collaboration	2011 submitted to A&A
Planck early results 20: New light on anomalous microwave emission from spinning dust grains	Planck Collaboration	2011 submitted to A&A
Planck early results 21: Properties of the interstellar medium in the Galactic plane	Planck Collaboration	2011 submitted to A&A
Planck early results 22: The submillimetre properties of a sample of Galactic cold clumps	Planck Collaboration	2011 submitted to A&A
Planck early results 23: The Galactic cold core population revealed by the first all-sky survey	Planck Collaboration	2011 submitted to A&A
Planck early results 24: Dust in the diffuse interstellar medium and the Galactic halo	Planck Collaboration	2011 submitted to A&A
Planck early results 25: Thermal dust in nearby molecular clouds	Planck Collaboration	2011 submitted to A&A

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Papiers Mission

Papier Catalogue

Papiers Amas

Papiers Galaxies

Papiers Voie Lactée

La mission

Planck Goals in perspective

("Blue Book", twice better than requirements)

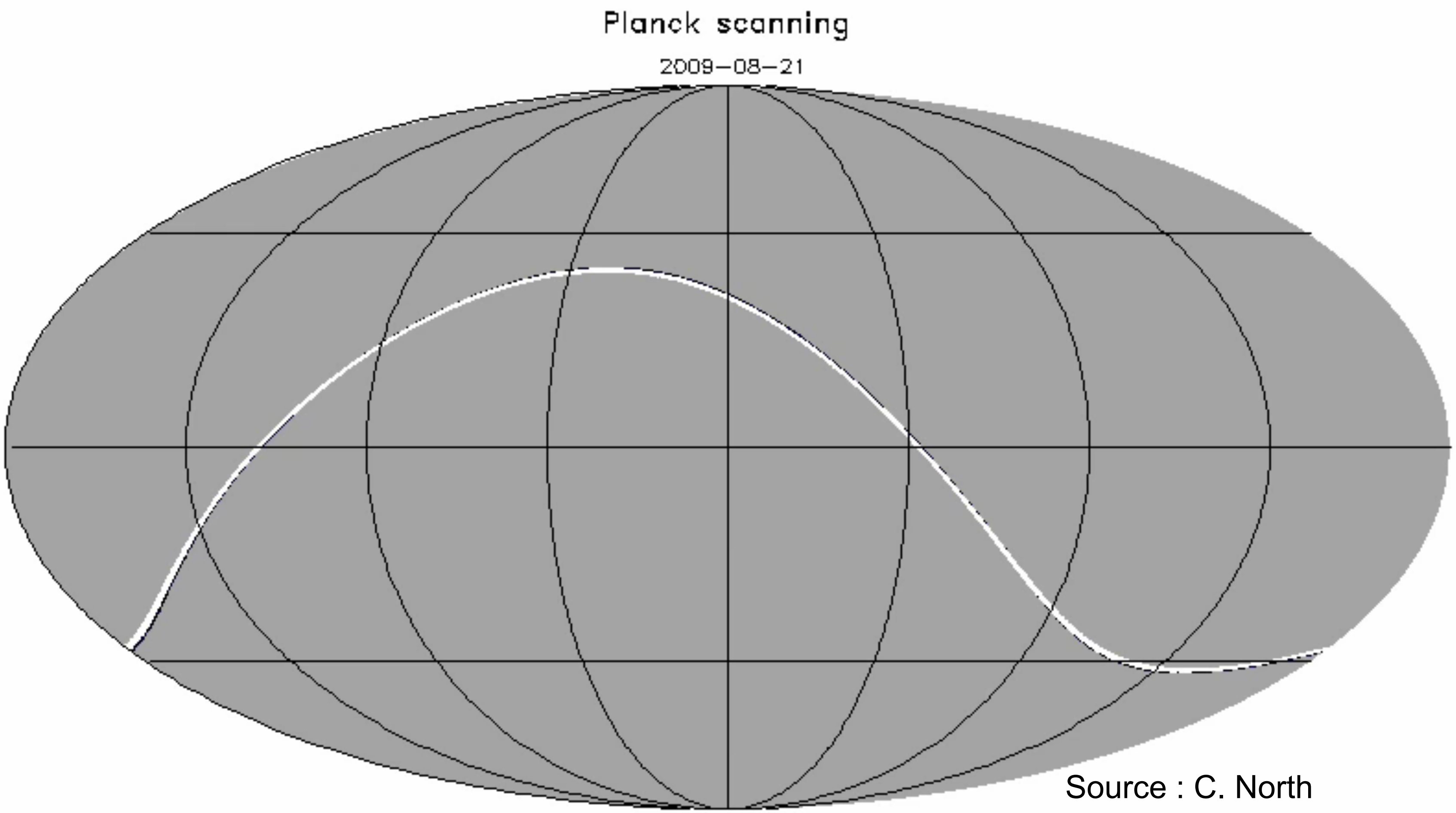
PLANCK	LFI			HFI					
Center Freq (GHz)	30	44	70	100	143	217	353	545	857
Angular resolution (FWHM arcmin)	33	24	14	10	7.1	5.0	5.0	5	5
Sensitivity in I [μK.deg] [$\sigma_{pix}\ \Omega_{pix}^{1/2}$]	3.0	3.0	3.0	1.1	0,7	1.1	3.3	33	3.0

WMAP Center Freq.	23	33	41	61	94
Angular resolution (FWHM arcmin)	49	37	29	20	12,6
Sensitivity in I [μK.deg], 1 yr (8 yr)	12.6 (4.5)	12.9 (4.6)	13.3 (4.7)	15.6 (5.5)	15.0 (5.3)

The aggregated sensitivity of Planck core CMB channels is ~0.5μK.deg in T (nominal mission – 14months)

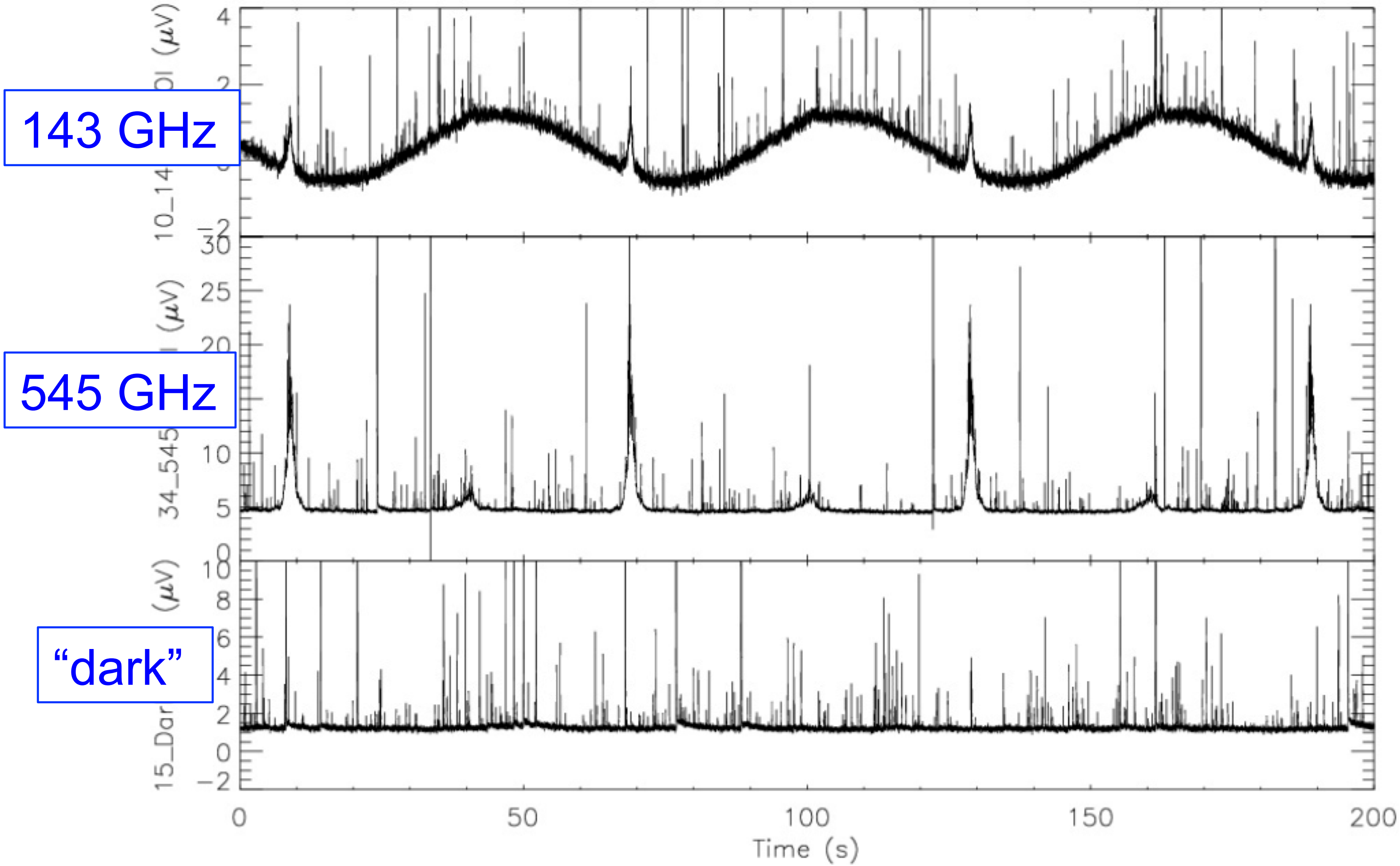
NB: Anticipated survey duration is now ~30 months, so final sensitivity ~0.33 μK.deg in T (approx 1000 years of WMAP 60+90GHz aggregated sensitivity of 10.8 μK.deg in1yr)

Première couverture du ciel de Planck

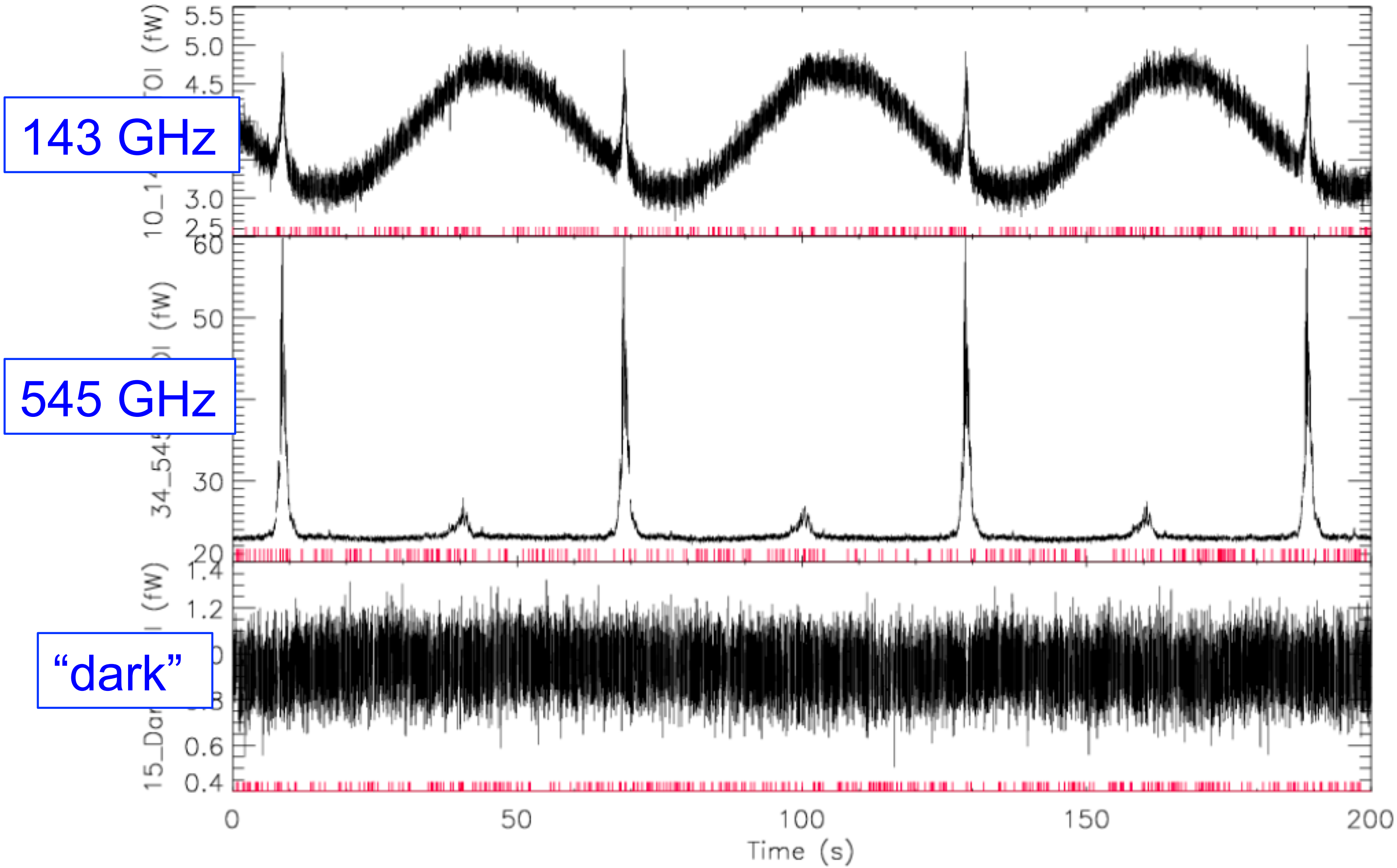


Source : C. North

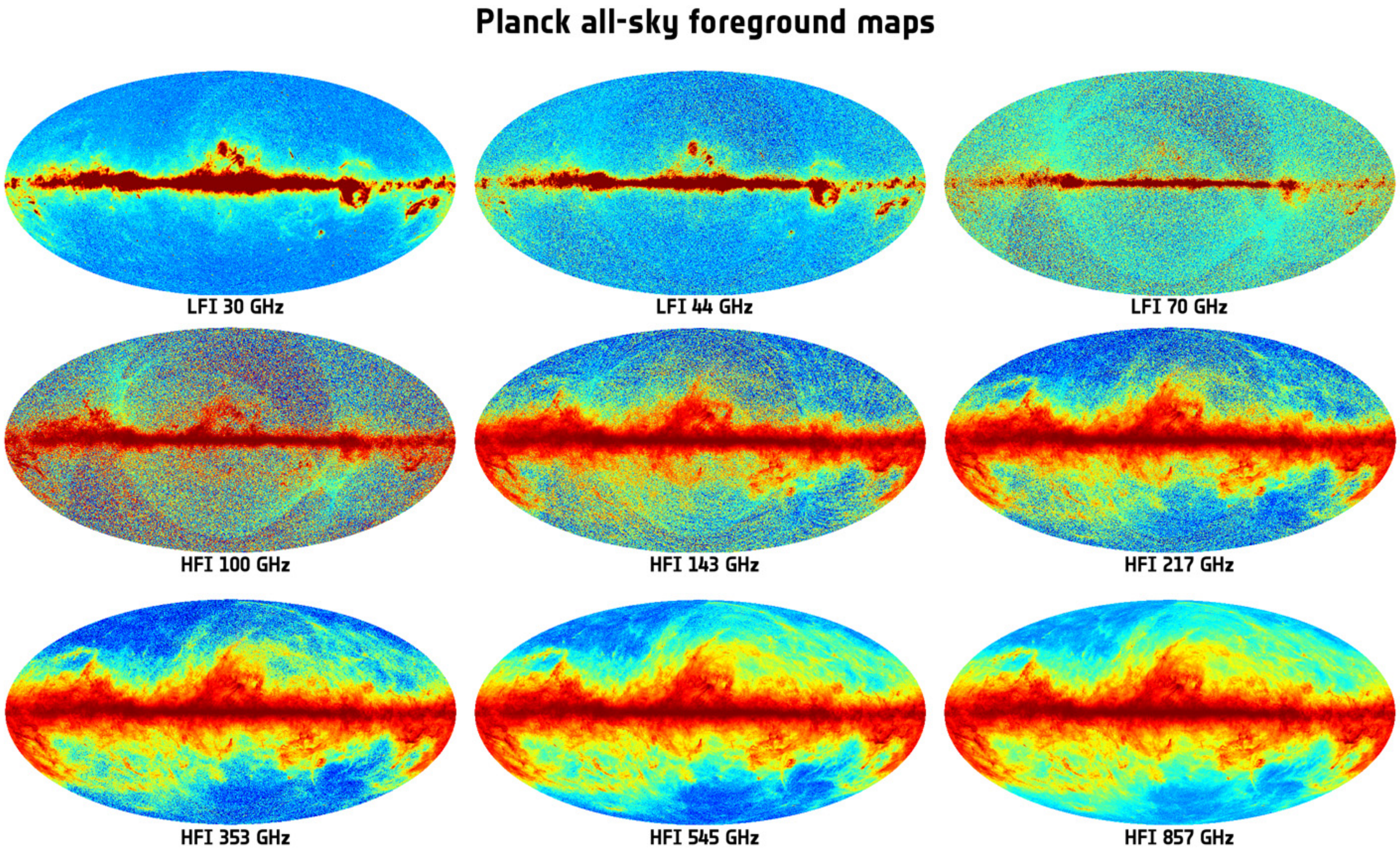
Les données HFI brutes



Les données HFI traitées



Les cartes Planck



The Early Release Compact Source Catalogue

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ERCSC

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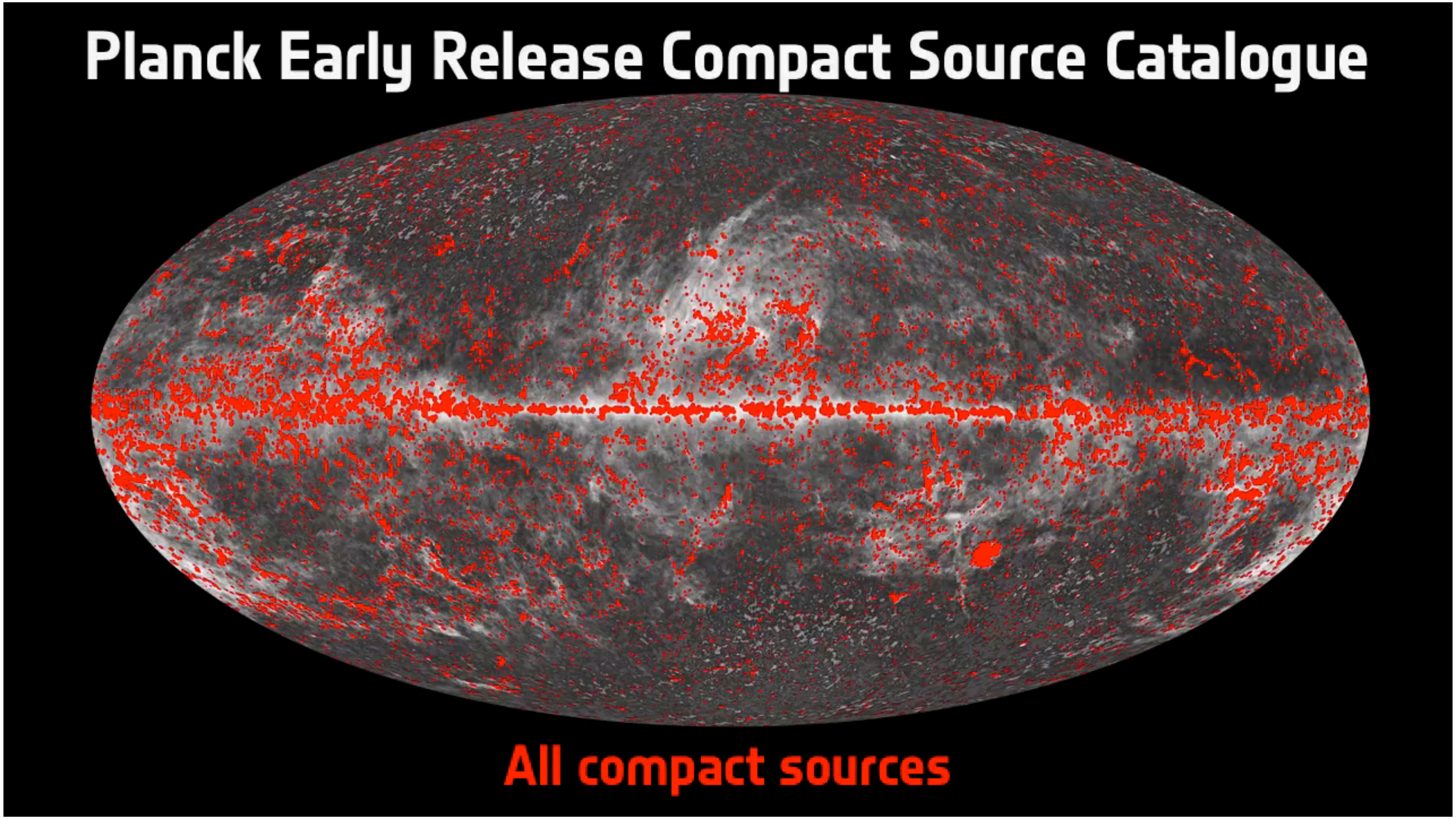


ERCSC

Plus de **15000 sources** compactes

Galaxies radio et infrarouges

Structures de notre galaxie

Etoiles

⇒ 951 cold cores (ECC)

⇒ 189 amas de galaxies (ESZ)

Les amas de galaxies

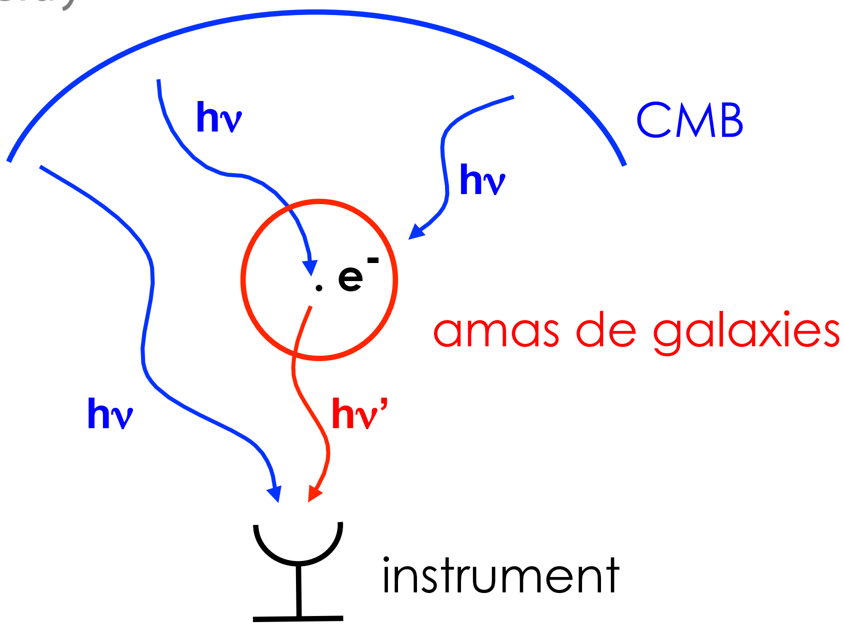
Un premier pas (de géant) vers les paramètres cosmologiques

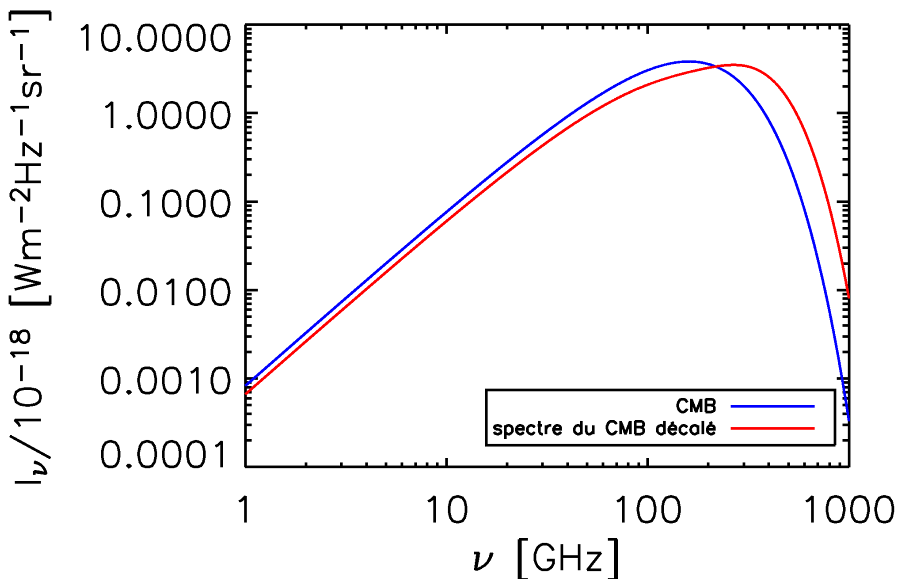
Du catalogue d'amas aux paramètres cosmologiques

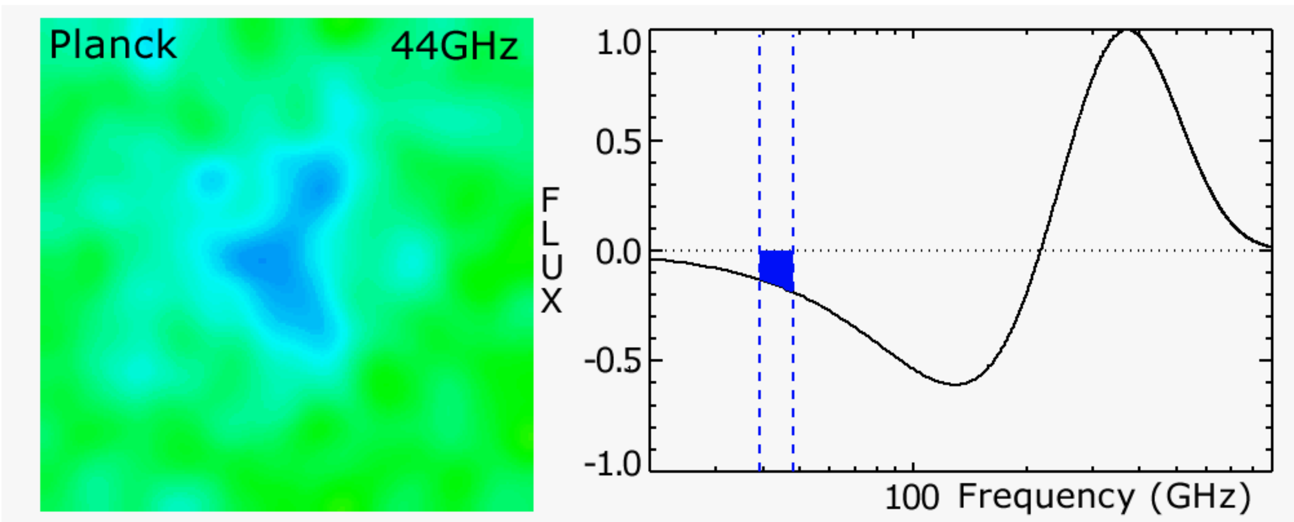
- **Détection d'amas**
  - L'effet SZ est sous-dominant à toutes les fréquences !
- **Connaissance de la fonction de sélection (=efficacité)**
  - lien entre nombre d'amas observés et théoriques
- **Maîtrise des effets systématiques**
  - instrumentaux
  - physique (des amas)

Observation à **d'autres longueurs d'onde** (X et optique)
Lois d'échelles : Flux en fonction de la masse et du redshift

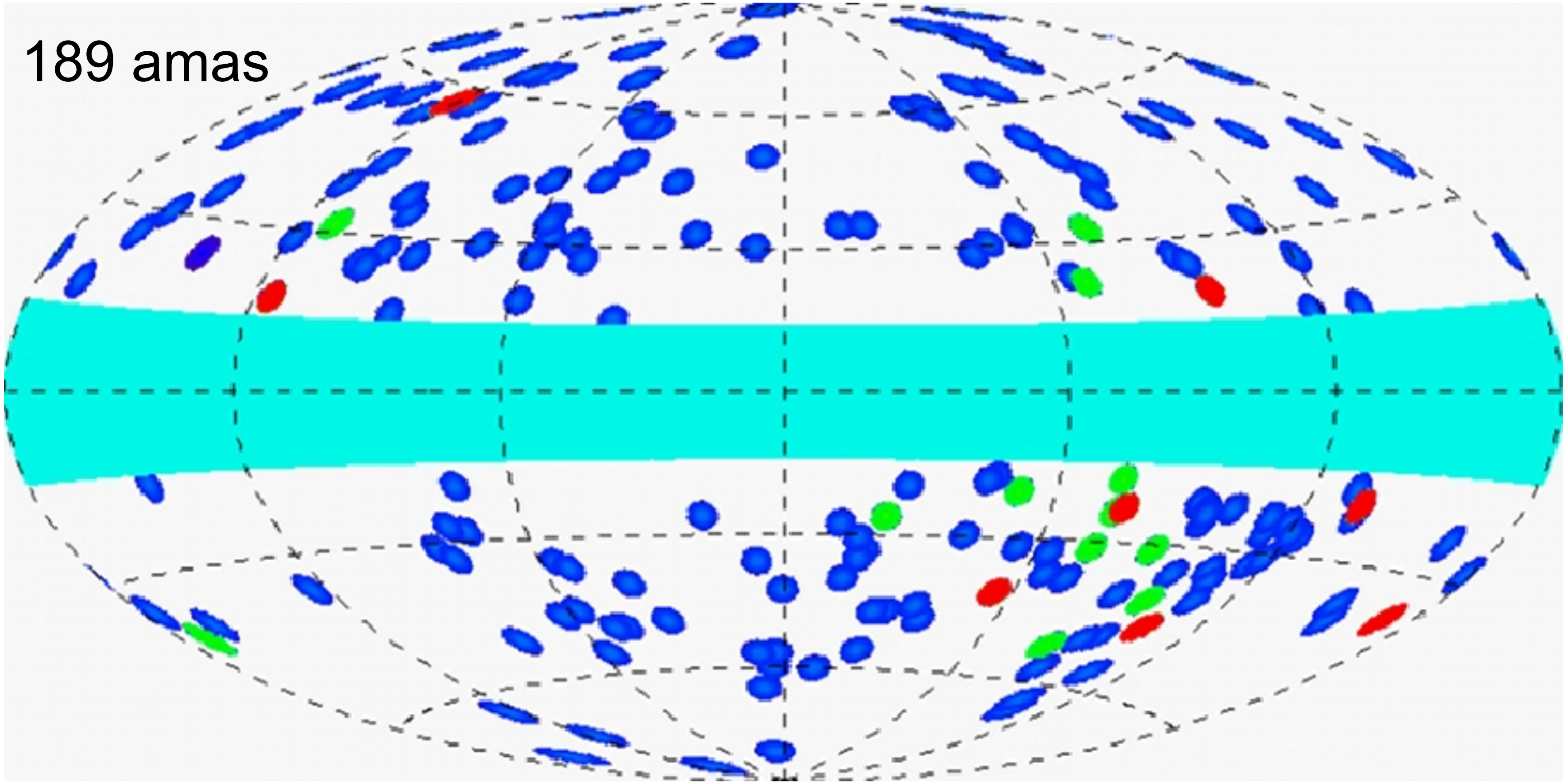
Détecter les amas avec l'effet SZ





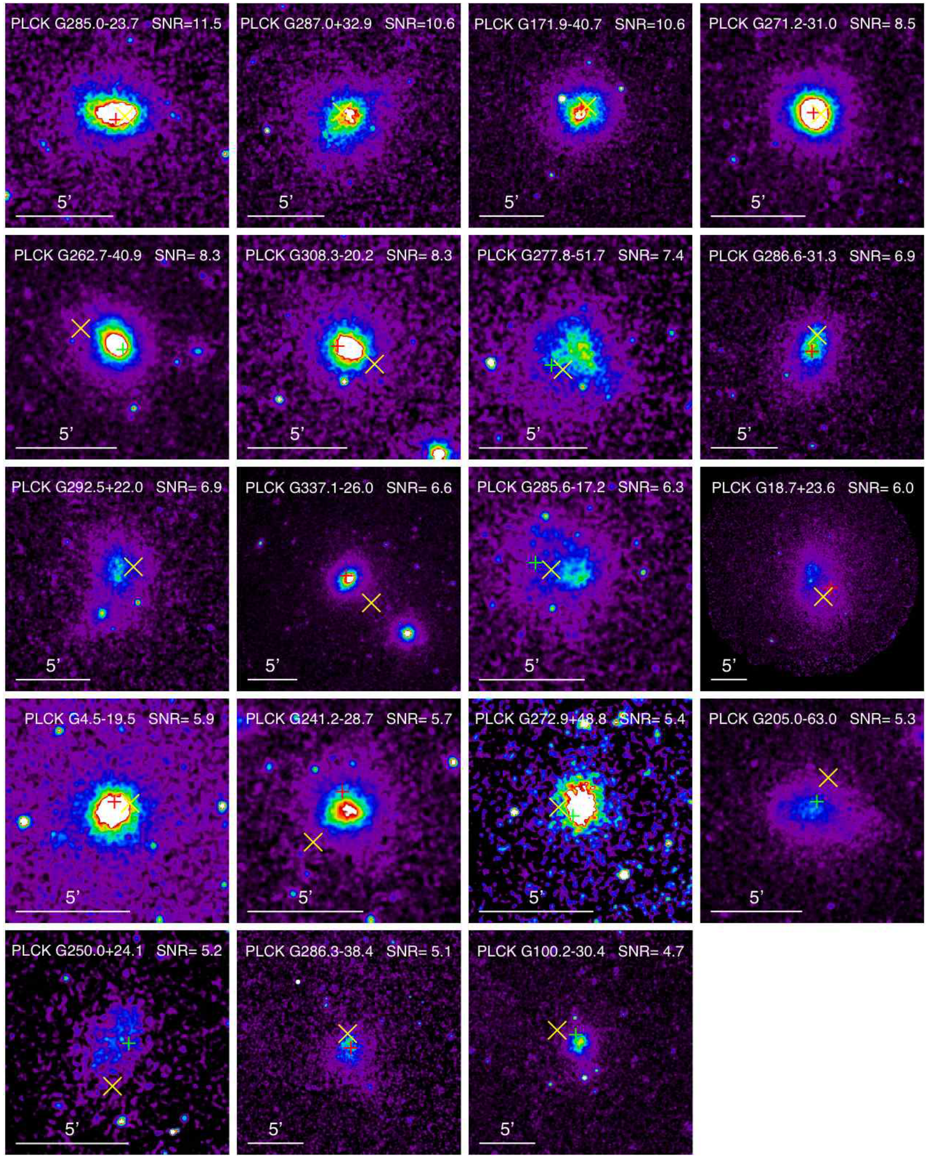


Les premiers amas Planck



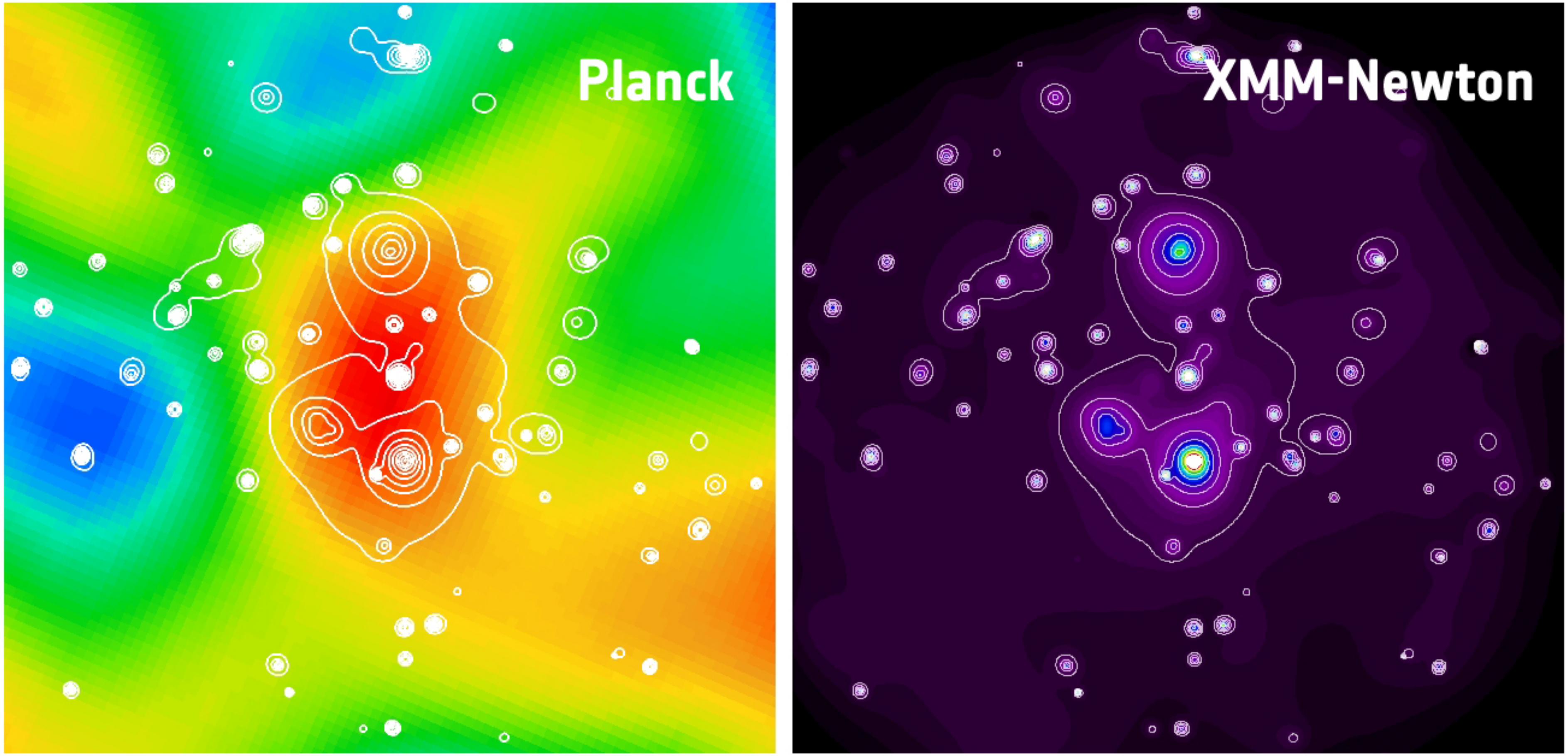
bleus : amas connus
verts : nouveaux confirmés par XMM
rouges : nouveaux à confirmer

Amas suivis par XMM Newton



Mise en évidence
d'une nouvelle population d'amas
(**morphologie perturbée**)
manquée par les sondages en X

Détections inattendues



Superamas Planck

Lois d'échelles SZ - X

Un débat de plus de cinq ans

arXiv:1001.4538v3 [astro-ph.CO] 9 Nov 2010

Dernière version

SEVEN-YEAR WILKINSON MICROWAVE ANISOTROPY PROBE (*WMAP*[1]) OBSERVATIONS: COSMOLOGICAL INTERPRETATION

E. Komatsu[2], K. M. Smith[3], J. Dunkley[4], C. L. Bennett[5], B. Gold[5], G. Hinshaw[6], N. Jarosik[7], D. Larson[5], M. R. Nolta[8], L. Page[7], D. N. Spergel[3,9], M. Halpern[10], R. S. Hill[11], A. Kogut[6], M. Limon[12], S. S. Meyer[13], N. Odegard[11], G. S. Tucker[14], J. L. Weiland[11], E. Wollack[6], and E. L. Wright[15]

Accepted for Publication in the Astrophysical Journal Supplement Series

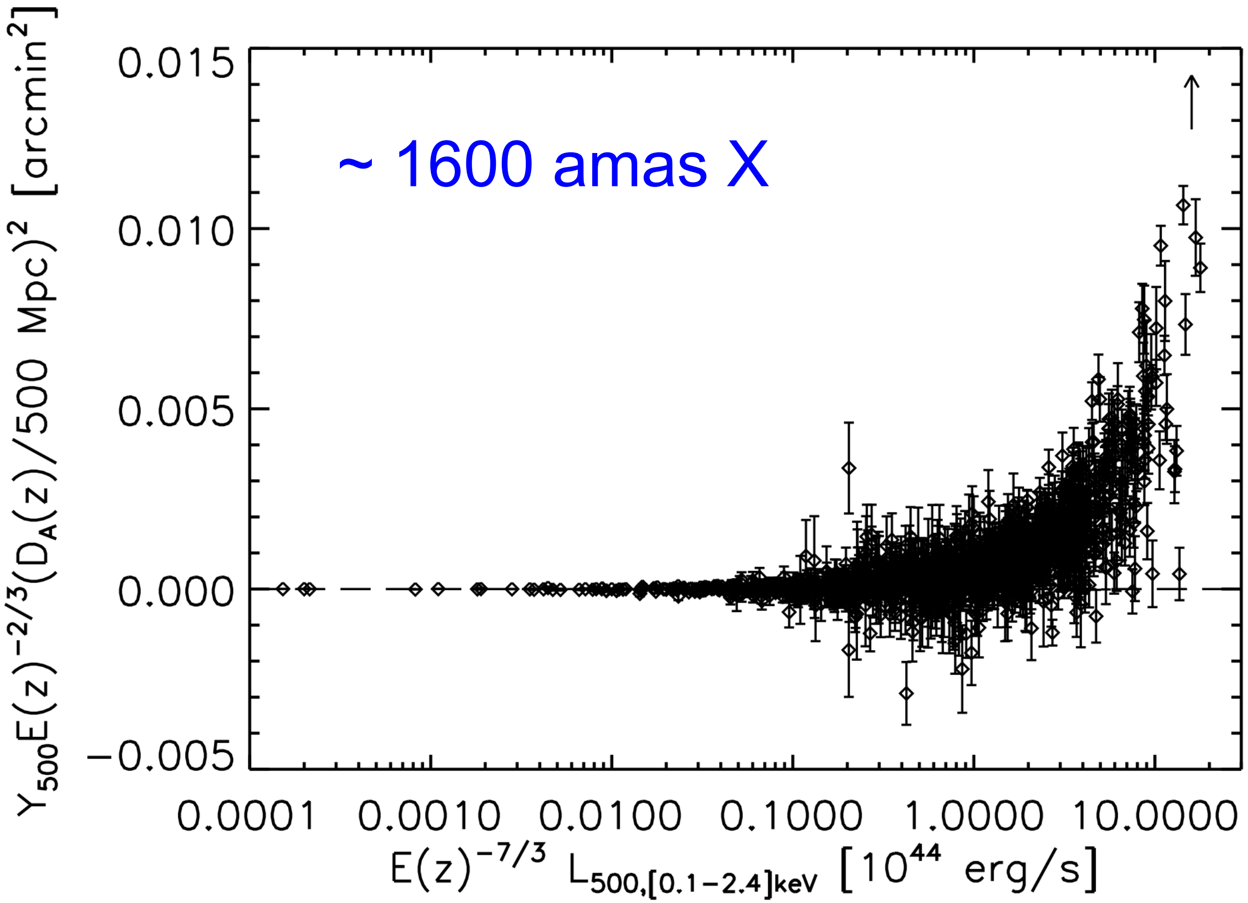
ABSTRACT

The combination of 7-year data from *WMAP* and improved astrophysical data rigorously tests the standard cosmological model and places new constraints on its basic parameters and extensions. By combining the *WMAP* data with the latest distance measurements from the Baryon Acoustic Oscillations (BAO) in the distribution of galaxies (Percival et al. 2009) and the Hubble constant (H_0) measurement (Riess … …ters of the simplest 6-parameter ΛCDM model. The power-l… …ctrum is $n_s = 0.968 \pm 0.012$ (68% CL) for this data combina… … Harrison-Zel'dovich-Peebles spectrum by 99.5% CL. The other parameters, including those beyond the minimal set, are also consistent with, and improved from, the 5-year results. We find no convincing deviations from the minimal model. The 7-year temperature power spectrum gives a better determination of the third acoustic peak, which results in a better determination of the redshift of the matter-radiation equality epoch. Notable examples of improved parameters are the total mass of neutrinos, $\sum m_\nu < 0.58$ eV (95% CL), and the effective number of neutrino species, $N_{\rm eff} = 4.34^{+0.86}_{-0.88}$ (68% CL), which benefit from better determinations of the third peak and H_0. The limit on a constant dark energy equation of state parameter from *WMAP*+BAO+H_0, without high-redshift Type Ia supernovae, is $w = -1.10 \pm 0.14$ (68% CL). We detect the effect of primordial helium on the temperature power spectrum and provide a new test of big bang nucleosynthesis by measuring $Y_p = 0.326 \pm 0.075$ (68% CL). We detect, and show on the map for the first time, the tangential and radial polarization patterns around hot and cold spots of temperature fluctuations, an important test of physical processes at $z = 1090$ and the dominance of adiabatic scalar fluctuations. The 7-year polarization data have significantly improved: we now detect the temperature-E-mode polarization cross power spectrum at 21σ, compared to 13σ from the 5-year data. With the 7-year temperature-B-mode cross power spectrum, the limit on a rotation of the polarization plane due to potential parity-violating effects has improved by 38% to $\Delta\alpha = -1.1^\circ \pm 1.4^\circ$ (statistical) $\pm 1.5^\circ$ (systematic) (68% CL). We report significant detections of the Sunyaev-Zel'dovich (SZ) effect at the locations of known clusters of galaxies. The measured SZ signal agrees well with the expected signal from the X-ray data on a cluster-by-cluster basis. However, it is a factor of 0.5 to 0.7 times the predictions from "universal profile" of Arnaud et al., analytical models, and hydrodynamical simulations. We find, for the first time in the SZ effect, a significant difference between the cooling-flow and non-cooling-flow clusters (or relaxed and non-relaxed clusters), which can explain some of the discrepancy. This lower amplitude is consistent with the lower-than-theoretically-expected SZ power spectrum recently measured by the South Pole Telescope collaboration.

Subject headings: cosmic microwave background, cosmology: observations, early universe, dark matter, space vehicles, space vehicles: instruments, instrumentation: detectors, telescopes

Lois d'échelles SZ - X

Un débat de plus de cinq ans

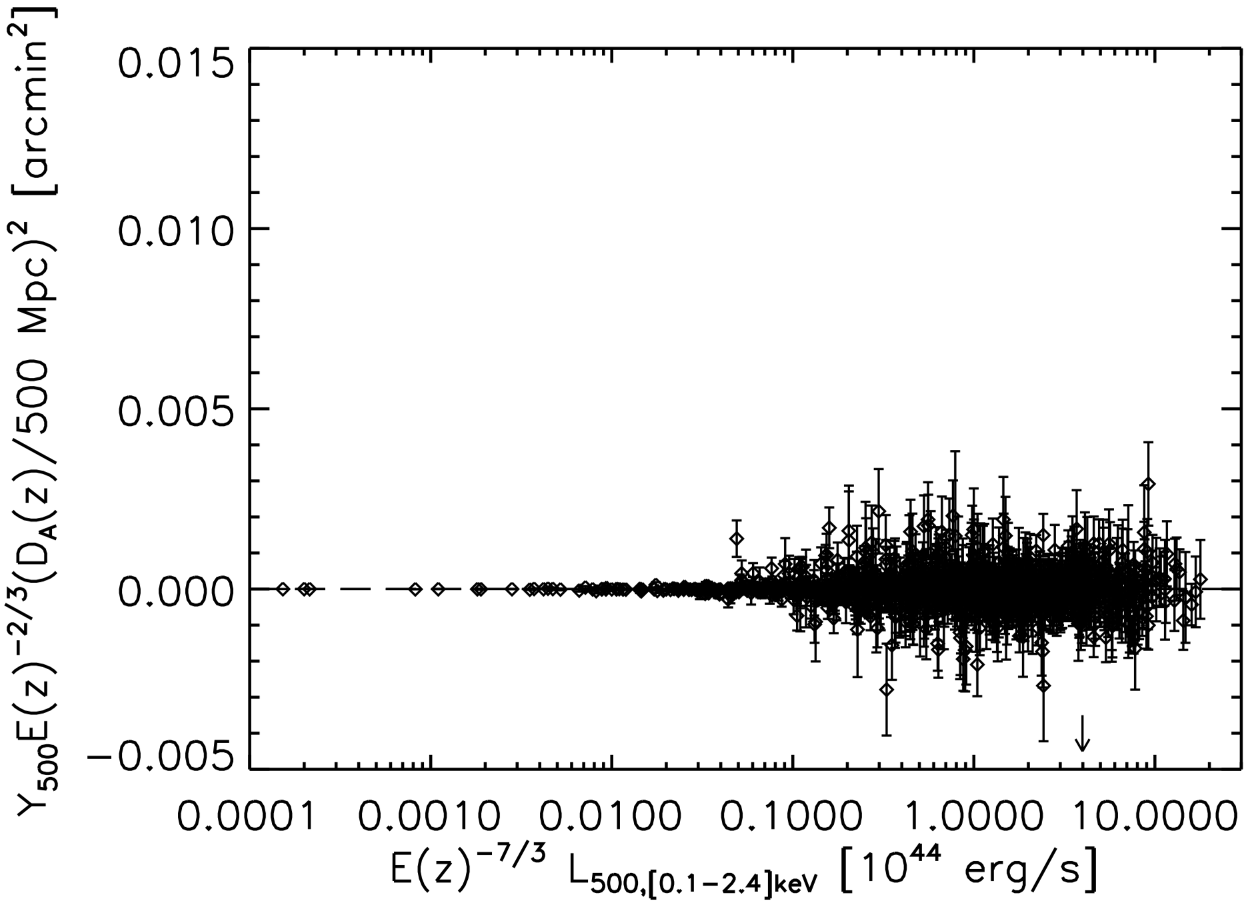


Luminosité SZ

Luminosité X

Lois d'échelles SZ - X

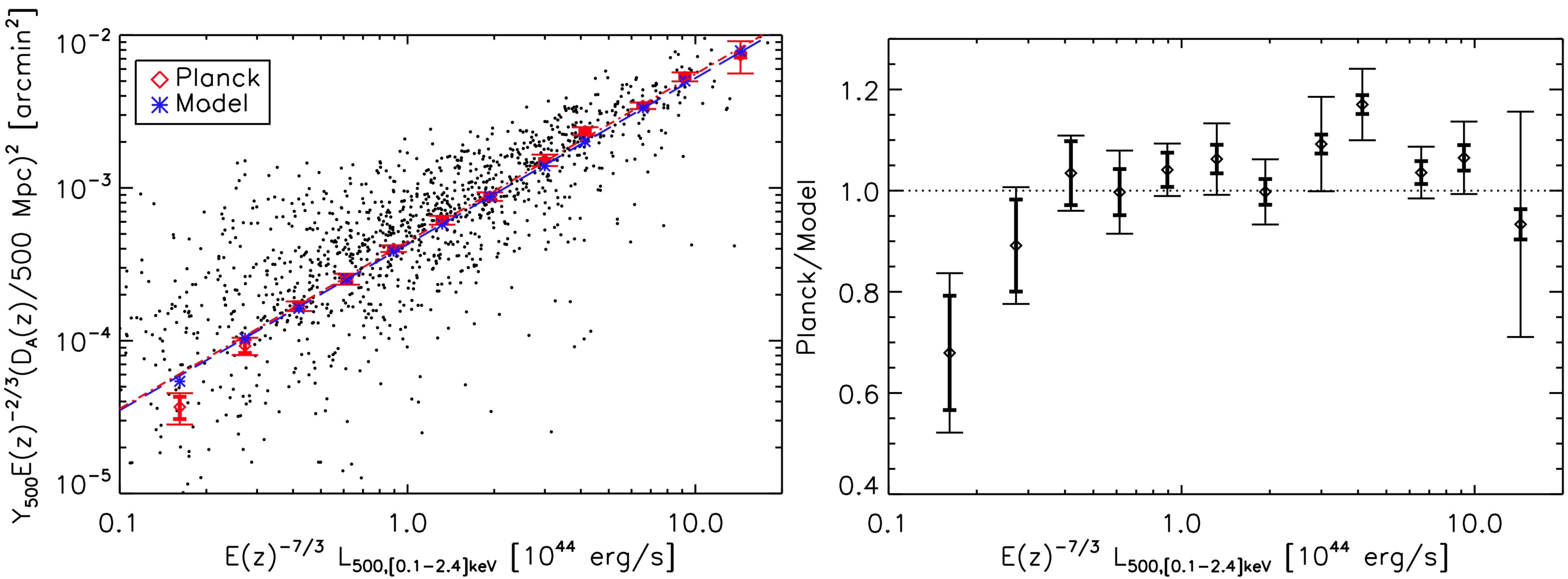
Un débat de plus de cinq ans



positions aléatoires

Lois d'échelles SZ - X

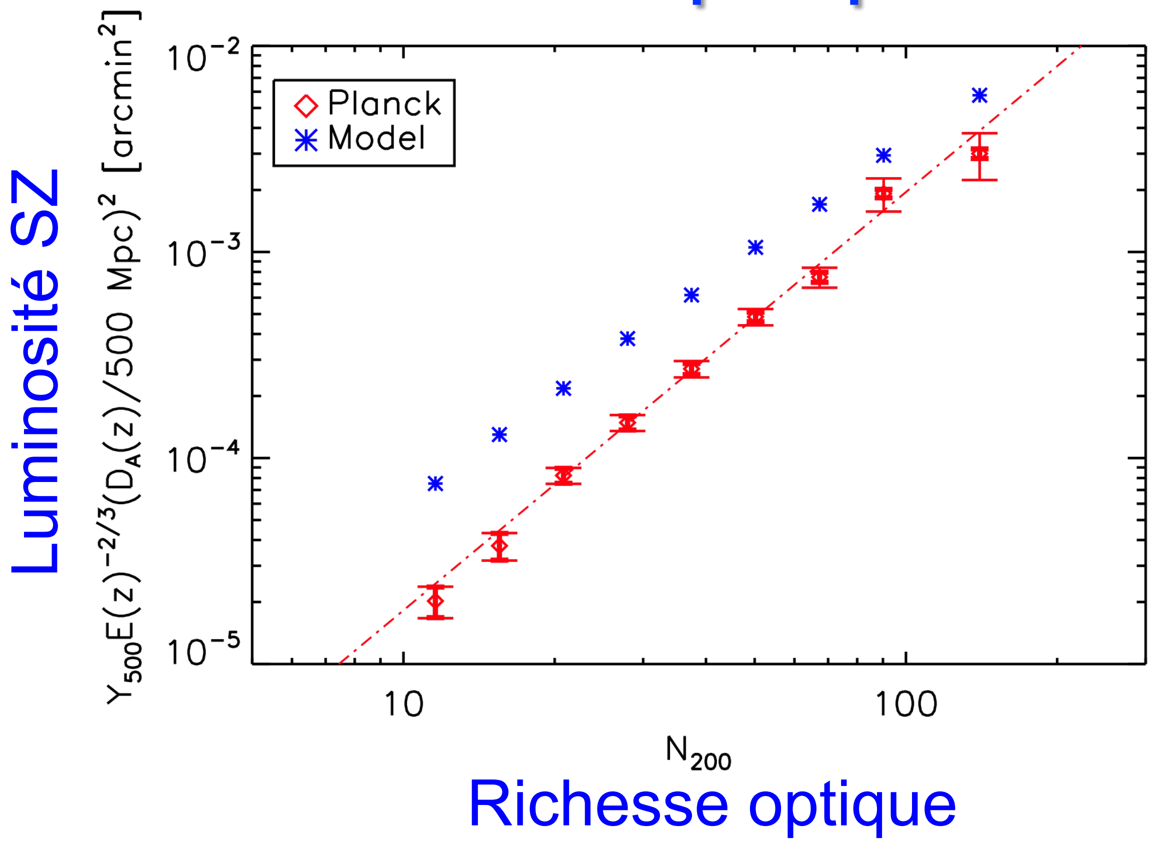
Un débat de plus de cinq ans



Parfait accord entre le SZ et les X
Résultat confirmé sur échantillon d'amas local (ESZ)
On maîtrise les lois d'échelle…

Lois d'échelles SZ - optique

On maîtrise les lois d'échelle…
…**enfin presque**



13000 amas MaxBCG (SDSS)

Désaccord entre modèle et observation pour les amas optiques. En cours d'investigation.

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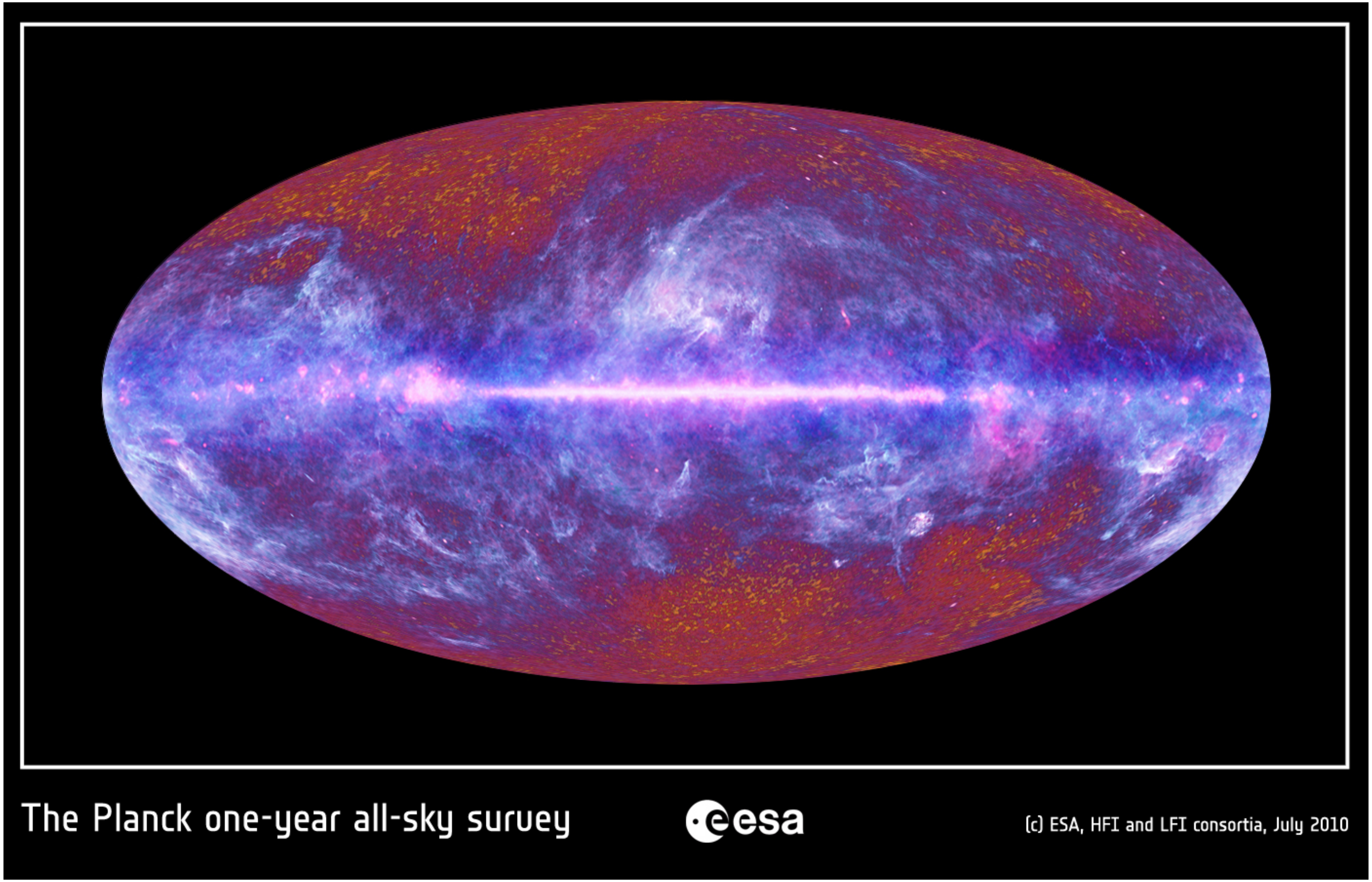
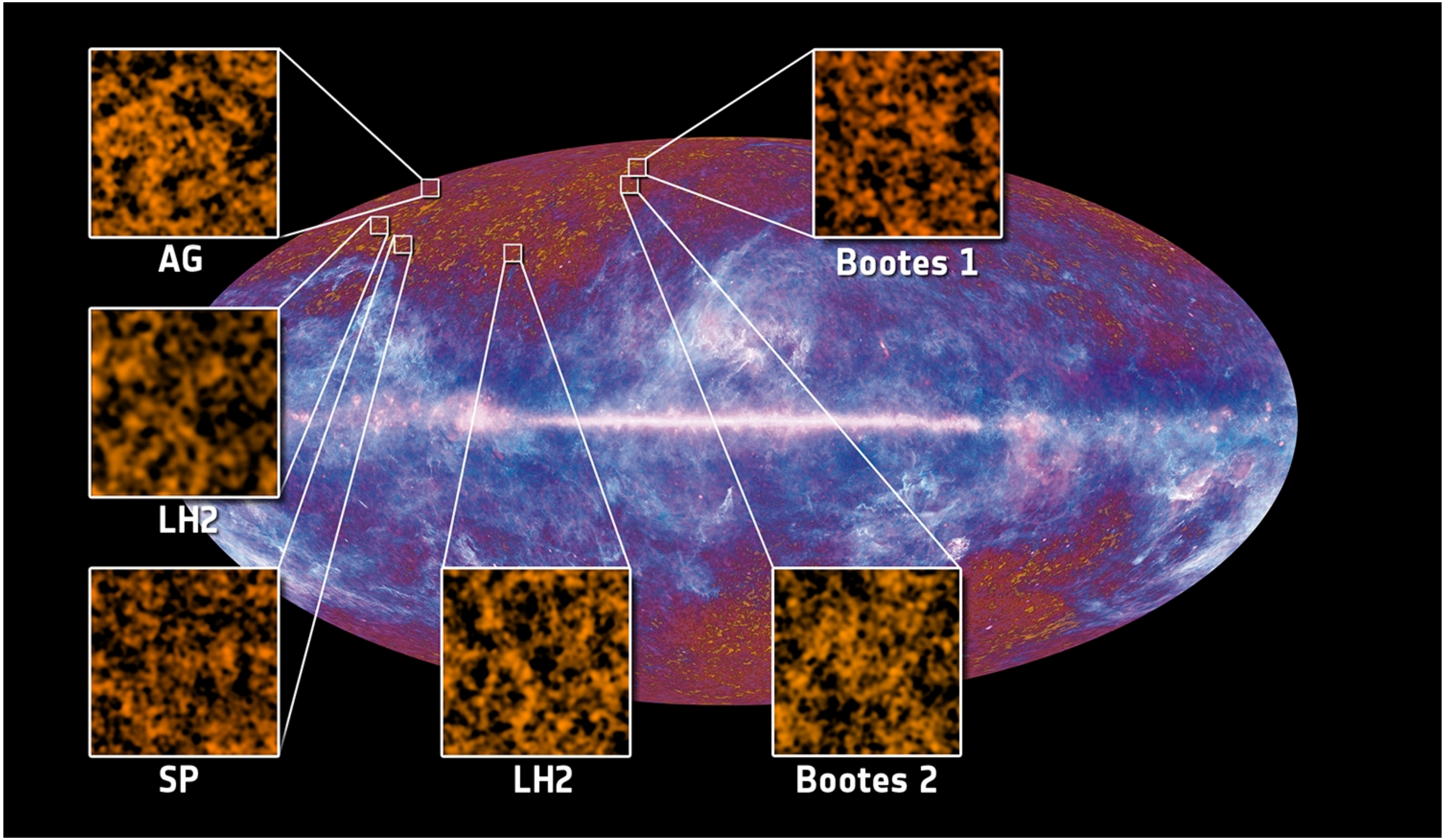
Les galaxies

Caractérisation des anisotropies du fond diffus infrarouge

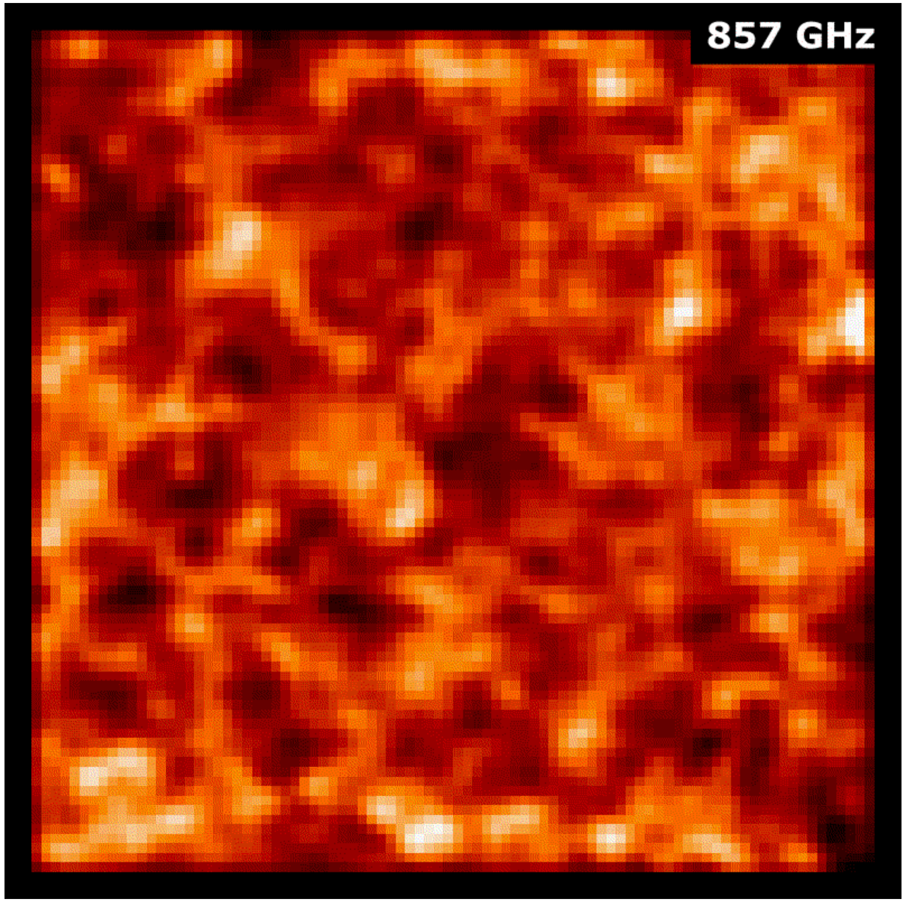
Anisotropies du fond diffus infrarouge (CIBA)



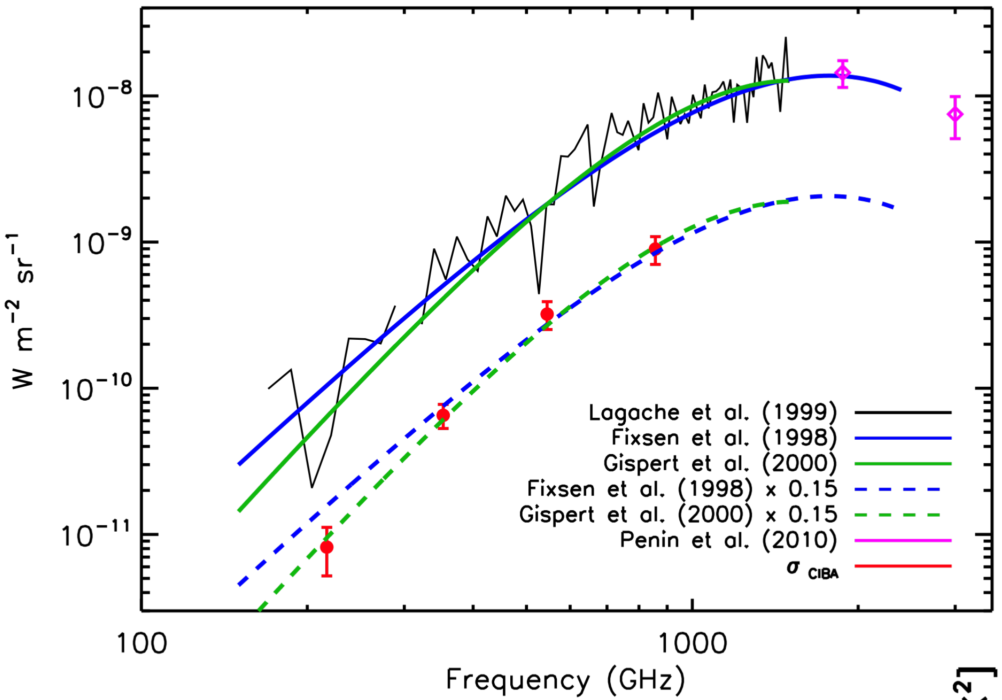
Anisotropies du fond diffus infrarouge (CIBA)



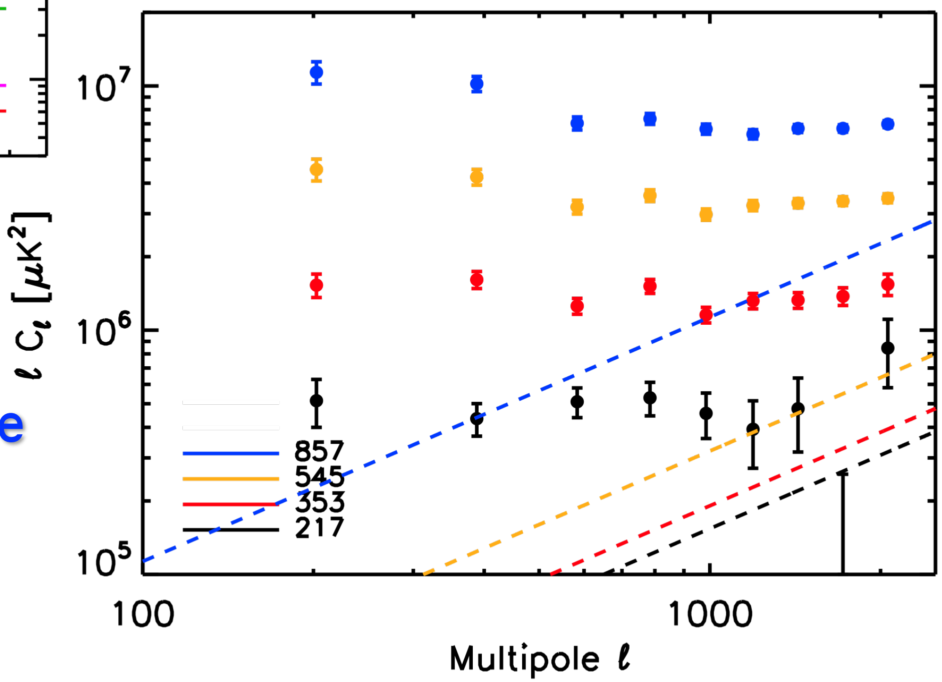
Anisotropies du fond diffus infrarouge (CIBA)



Anisotropies du fond diffus infrarouge (CIBA)



Mesure du spectre des CIBA entre l=200 et l=2000 à 857, 545, 353, 217GHz



Rejette le modèle de halos simple avec biais linéaire constant

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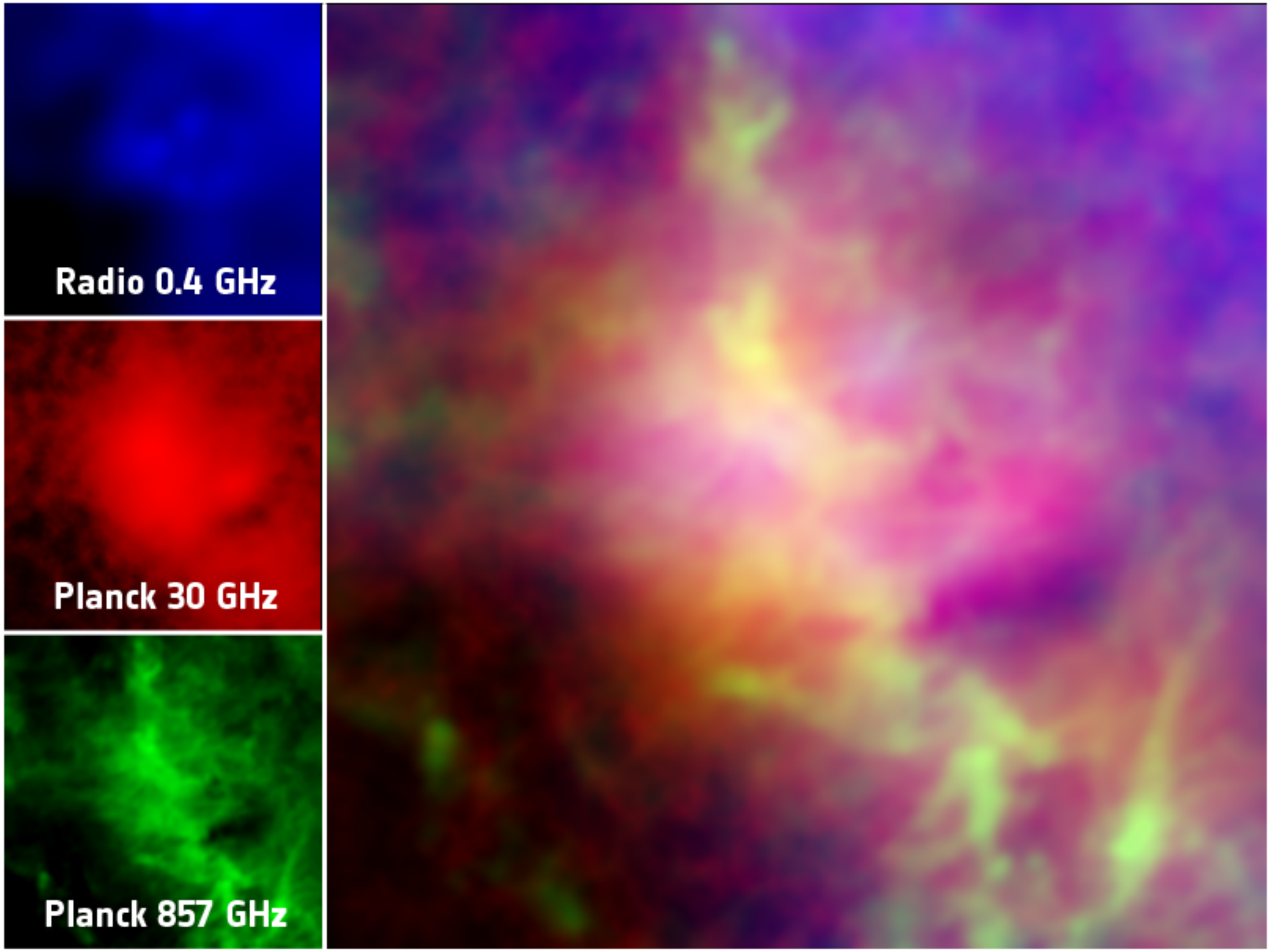
La Voie Lactée

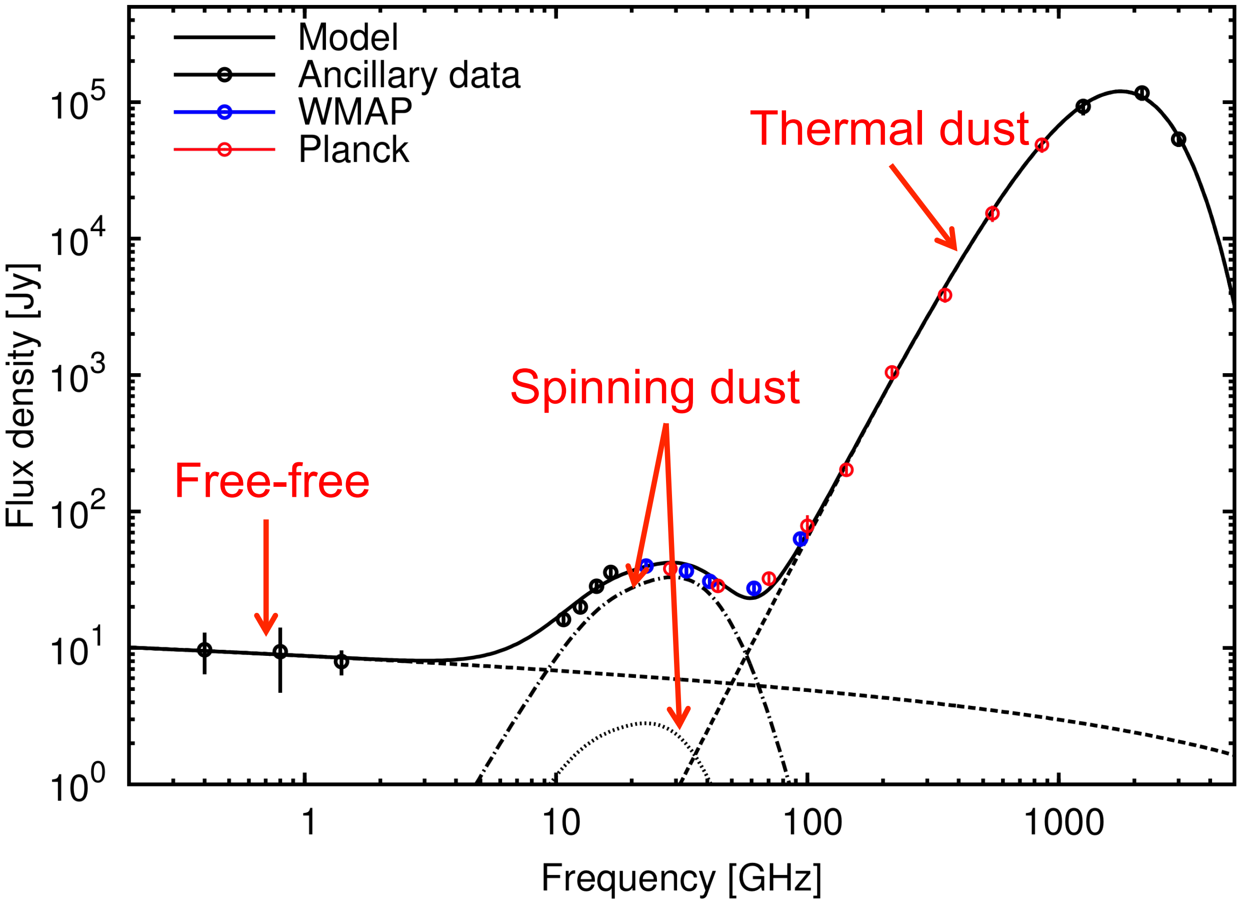
Emission anormale des poussières
Anomalous Microwave Emission (AME)

Emission anormale des poussières (AME)



Persée

Emission anormale des poussières (AME)



Contraintes précises sur le spectre de la composante « spinning dust »

La Voie Lactée

La poussière dans le milieu interstellaire

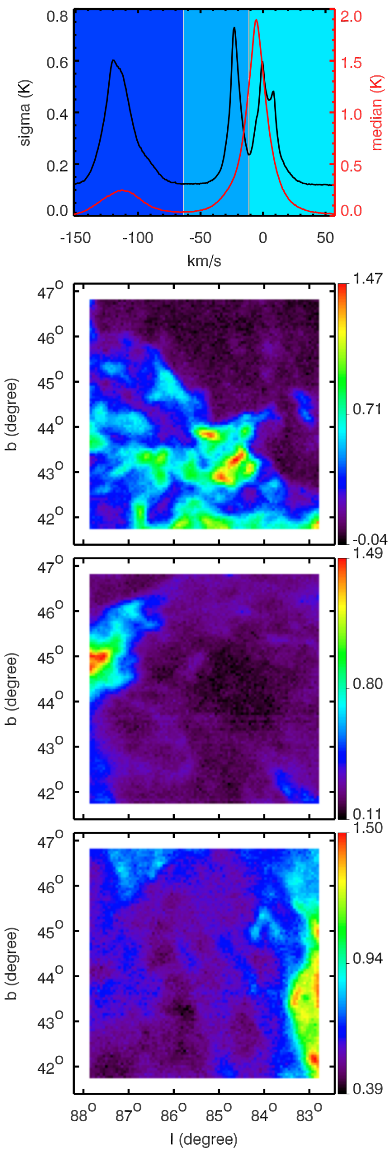
La poussière dans le milieu interstellaire

L'hydrogène neutre HI
comme traceur de la poussière

Local

Intermediate Velocity Cloud (IVC)

High Velocity Cloud (HVC)



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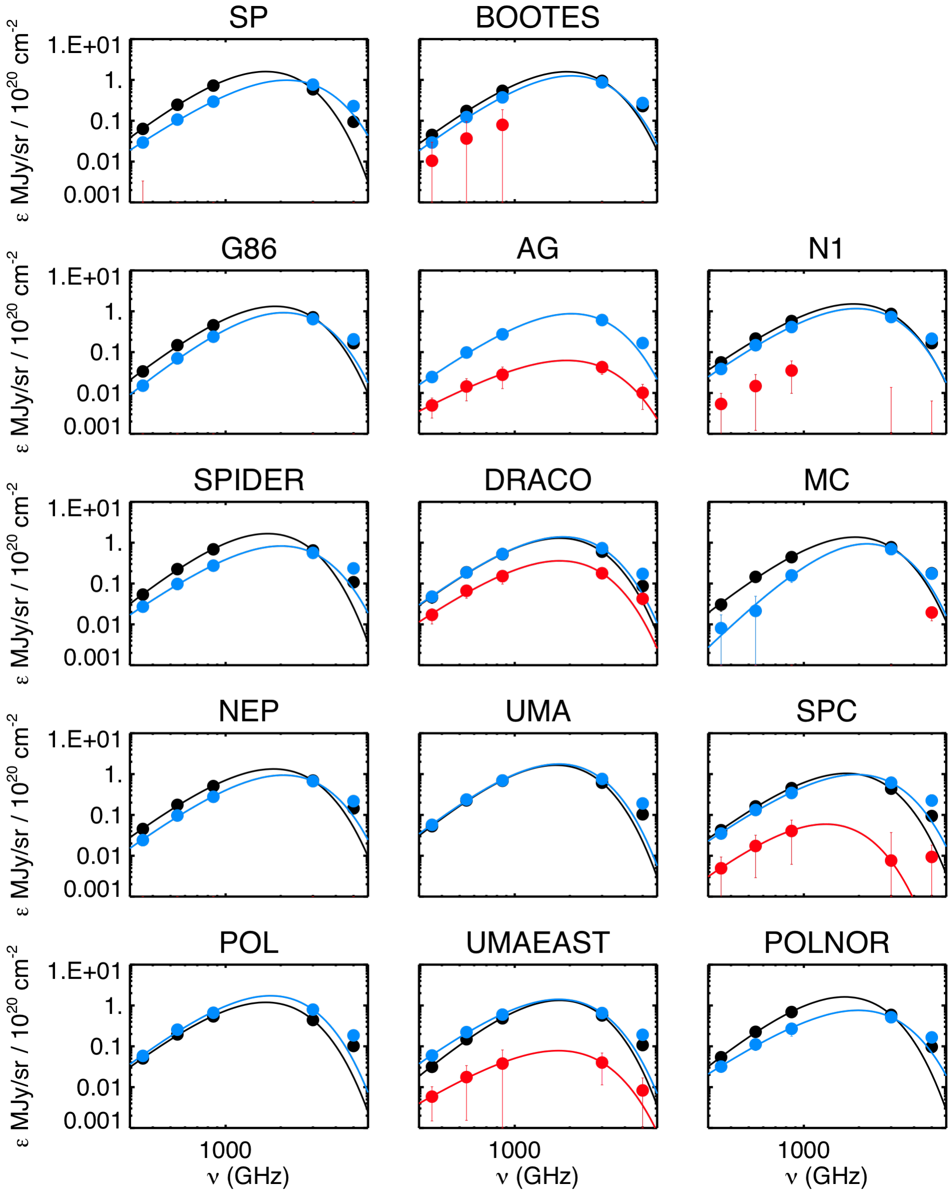
La poussière dans le milieu interstellaire



Lois d'émissions pour différentes régions

noir : local
bleu : IVC
rouge : HVC

Résumé - Perspectives

25 papiers scientifiques

- Catalogue de 15000 sources (951 « cold cores », 189+10 amas)

- Physique des amas de galaxies, galaxies, Voie Lactée

- Résultats Voie Lactée et CIB obtenus à grand S/N
Par contre, couvertures du ciel supplémentaires importantes pour les amas de galaxies, les galaxies… et le fond diffus cosmologique

- Connaissances acquises utiles pour extraire le fond diffus cosmologique (intensité et polarisation), les spectres de puissance et obtenir les contraintes sur les paramètres cosmologiques

- Autres publications cette année, **publications sur le CMB début 2013**

A suivre...

The scientific results that we present today are a product of the Planck Collaboration, including individuals from more than 50 scientific institutes in Europe, the USA and Canada

Planck is a project of the European Space Agency -- ESA -- with instruments provided by two scientific Consortia funded by ESA member states (in particular the lead countries: France and Italy) with contributions from NASA (USA), and telescope reflectors provided in a collaboration between ESA and a scientific Consortium led and funded by Denmark.